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# SCIENCE

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## THE STRUCTURE OF ATOMS, AND THE EVOLUTION OF THE ELEMENTS AS RELATED TO THE COMPOSITION OF THE NUCLEI OF ATOMS<sup>1</sup>

THE general theory of the structure of the atom which seems to be most closely in harmony with the facts is that developed by Rutherford. His theory assumes that the atom consists of a central nucleus or sun, and that the satellites of the miniature solar system are the negative electrons. The central nucleus is supposed to contain almost all of the mass of the atom, and is charged with positive electricity. That this nucleus is very minute in comparison with the size of the atom is indicated by the work of Rutherford, of Geiger and Marsden, and of Darwin, who find that the deflection of alpha particles, which are shot from radioactive atoms at speeds which approach 20,000 miles per second and so pass directly through other atoms, is of such a character as to indicate that the positive charge of the atom is very highly concentrated. Thus Darwin's work indicates that the maximum diameter of the nucleus of a hydrogen atom ( $1.7 \times 10^{-13}$  cm.) is only about one-one hundred thousandth of the diameter usually assumed for the atom. On this basis the atom would have a volume a million-billion times larger than that of its nucleus, and thus the nucleus of the atom is much smaller in com-

<sup>1</sup> Address presented at the Symposium on the Structure of Matter at the New York meeting of the American Association for the Advancement of Science. A bibliography will be found in the following papers: *Jour. American Chemical Society*, 37, 1367-1421 (1915), 39, 856-879 (1917); *Philosophical Magazine*, 30, 723-734 (1915).